



## Case report

## Suicide with two shots to the head inflicted by a captive-bolt gun

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## ABSTRACT

An exceptional case of suicide with two shots to the head inflicted by a captive-bolt gun is reported here. The pathophysiology observed, and related literature, indicate that the capacity of the victim to fire a second shot depended on the depth of skull penetration by the first shot and the extent of damage to nerve structures. In this case, an ante mortem multi-detector computed tomography was possible. From discussion with the radiologist and a 3D reconstruction, the two-shot suicide scenario could be confirmed.

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## 1. Introduction

Captive-bolt guns are used by farmers and vets in the meat industry, mainly in Middle- European countries, for humane slaughter of animals.<sup>1</sup> All models consist of a cylindrical metal tube in which a single-blow bolt is located.<sup>2,3</sup> This is launched upon discharge of a powder cartridge using an arming ring and pressing the trigger. With the gun placed against the animal's forehead, discharge induces immediate irreversible unconsciousness which precedes slaughter. After each shot, the user must open the chamber, remove the residue and put in a fresh cartridge for the next shot. Since 1937,<sup>4</sup> several reports of fatalities caused by captive-bolt guns have been published, mainly in German-language forensic literature. They describe in detail the morphologic aspect of the skin wounds (sharp-edged circular punched skin defect, with typical soot deposits depending on the number and location of gas outlet holes), the bone entry hole (round punched bone defect, with peripheral fissures mostly in angled shots), the wound track (hemorrhagic tunnel of a length always greater than the bolt, with bone and hairy skin fragments at the end) and the absence of any bullet.<sup>5–18</sup> Some authors pointed out the importance of the appearance of the skin wound and soot deposit for elucidating unclear circumstances (suicide versus homicide).<sup>9,14,17</sup>

An exceptionally rare case of suicide, from two shots to the head inflicted by a captive-bolt gun, is reported here. The question of the capacity of action of the victim is discussed in the light of the literature, the pathophysiology and the use in this case of the multi-detector computed tomography (MDCT).

## 2. Case report

A 46 year-old single male butcher was discovered at his home, supine on a mattress, in coma (Glasgow score = 3) with two wounds to the head. On the mattress, to his left, there was a MATADOR® type n°3 captive-bolt gun (Fig. 1) with a cartridge case in the chamber and, to his right, another cartridge case. In the apartment, the police also discovered suicide letters. The victim was rushed to an Emergency Department, where multi-detector computed tomography(MDCT) showed two wounds to the head. The first wound was located in the left part of the frontal area, and presented a frontal haemo pneumosinus and a fracture of the posterior wall of the sinus, with external and internal bone fragments, but without cerebral injury. The second wound was located in the temporal area, and presented a typical hemorrhagic wound track, with bone fragments found near the entry and at the end of the track (Fig. 2). There was also sub-arachnoid haemorrhaging, subdural haematoma, blood in the lateral ventricle, hypodensity in the left sylvian and cerebral vascular areas, and massive oedema. Despite decompressive craniectomy, the prognosis remained poor, and in agreement with the family, life-

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**Fig. 1.** MDCT-2D reconstruction: typical haemorrhagic wound track in the left temporal area.

support was stopped seven days later. The autopsy was carried out the next day.

The MDCT-data was viewed by radiologists and forensic pathologists together. Given the characteristics of the weapon, MDCT-3D reconstructions were then performed. These showed the frontal injury was 3.5 cm in length, with an oblique trajectory from top to bottom (Fig. 3A and B). The temporal lesion measured 7.2 cm in length, with an oblique trajectory from top to bottom, left to right and slightly forwards (Fig. 3C and D). No radial or circular fractures were observed around either of the two orifices.

External visual examination showed two sutured round skin defects, each 13 cm in diameter, in the left frontal and temporal areas, without pockets under the skin. No smoke deposit was observed around them. Examination of the skull showed left temporal and frontal bone defects corresponding to the trepanation, and confirmed the MSCT images. No indirect fractures or skull

base fractures were observed. Brain and dura examination after fixation in formalin solution showed: two sutured round defects of the dura; no haemorrhagic lesion in the frontal part of the frontal lobe, a haemorrhagic necrotic tunnel in the left frontal and temporal lobes to the basal ganglia, with a bone and skin fragment at the end; frontal sub-arachnoid haemorrhage; cerebral oedema with left temporal and cerebellar involvement; lesion of the proximal part of the left sylvian artery; and lesion of the frontal part of the Willis polygon, associated with ischemia in the territories of the anterior cerebral arteries. The other organs did not show any pathological changes, and no defence lesions were found on the corpse.

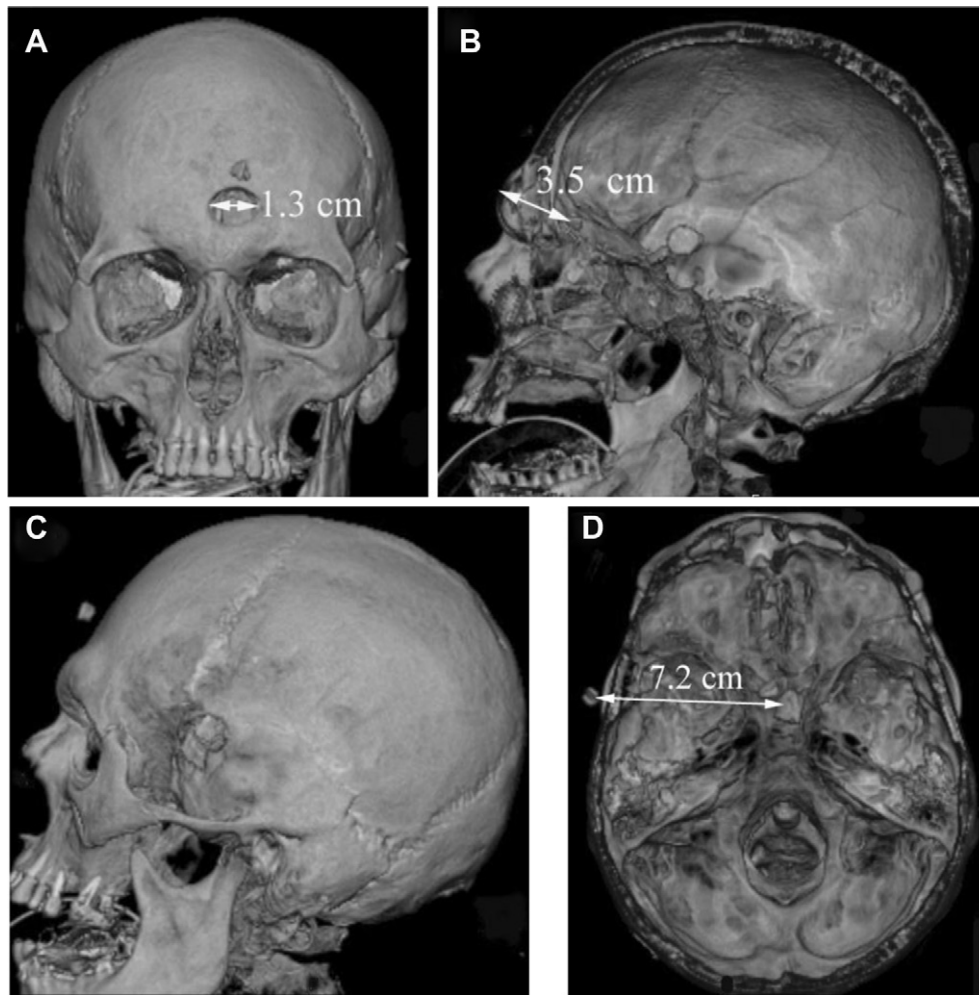
Toxicology analysis performed on samples on arrival in the emergency department found no alcohol in the bloodstream, but detected the drugs used in intensive care (thiopental, pentobarbital) in therapeutic ranges.

### 3. Discussion

As in any suicide case that involved two shots to the head, the question of the ability of the victim to fire the second shot was raised. Theoretically, the result of direct or primary (crush) bullet effects following gunshot wounds to the brain is immediate incapacitation.<sup>19</sup> This consists in the destruction of essential areas of the central nervous system, resulting in focal disturbance or elimination of consciousness.<sup>20</sup> In 5 cases of two captive-bolt gunshots to the head reported in the literature, including the present case, the first shot was consistently fired from a short distance, striking the frontal area.<sup>21–24</sup> It was associated with no or shallow lesions of the anterior part of the frontal lobe. In a sixth case, the wound lay outside the neurocranium (orbit).<sup>9</sup> According to the low velocity of the bolt ( $\approx 50 \text{ ms}^{-1}$ ) and the shallow penetration of the skull, these first shots did not appear to have caused cerebral contusion.<sup>19,25,26</sup> They were followed by a second shot, which required resetting the gun. These second shots were always to the victim's forehead near the first wound<sup>9,22–25</sup> and, in the present as in the other reported cases, in the left temporal region. In all cases, central nervous centres essential for physical activity were damaged by the crush effect of the bolt and/or by bone fragments acting as secondary projectiles. Measuring lesion depth compared to bolt length and assessing the affected brain structures were essential for judging the compatibility of such two-shots-to-the-head scenarios with suicide. Currently the value of postmortem MDCT is recognized in ballistics.<sup>27–29</sup> Where the victim does not die immediately, as in this observation, it is very useful to review ante-mortem images with radiologists to solve forensic questions such as the one posed in this observation.



**Fig. 2.** MATADOR® type n°3 captive-bolt gun (weight = 3.1 kg, total length = 31 cm, length of the bolt outside the cylinder = 6.5 cm, calibre of the bolt = 1.3 cm; side vents provide gas exhaust): general view and view of the muzzle (or mouth).



**Fig. 3.** MDCT-3D reconstruction. (A) Frontal view: round sutured defect of 1.3 cm diameter with external bone fragment in the frontal area and external bone fragments in the left temporal area - (B) Left sagittal section: internal frontal bone fragment located 3.5 cm deep and internal bone fragments in the temporal area - (C) Left lateral view: external bone fragments in the temporal and frontal areas. (D) Horizontal section: external and internal temporal bone fragments located 7.2 cm deep and internal frontal bone fragments.

#### Conflict of interest

None.

#### Ethical approval

None.

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